Claims

1. A method of controlling an object's motion through a viewed space comprising the steps of:

acquiring a stereo image of said viewed space wherein said stereo image comprises an image set;

computing a set of 3D features from said stereo image;

filtering from said set of 3D features to generate a set of filtered 3D features;

computing a trajectory of said set of filtered 3D features; and

generating a control signal influencing said objects motion in response to said trajectory.

2. The method according to claim 1 wherein said step of computing a set of 3D features includes the steps of:

edge-processing said stereo image to generate a plurality of connected edgelets;

identifying connected edgelets having length greater than a predetermined threshold as features;

matching features to generate disparities generated from different images in said image set; and

computing 3D locations of feature points according to said disparities and camera geometry.

3. The method according to claim 2 wherein said step of computing a set of 3D features further comprises the steps of:

merging horizontal and vertical disparities to form a set of selected disparities;

wherein said step of computing 3D locations of feature points is performed according to said set of selected disparities and said camera geometry.

4. The method according to claim 1 further comprising the step of:

segmenting said 3D features to identify mutually exclusive subsets of boundary point as objects;

wherein said set of filtered 3D features are generated by filtering ground plane noise from said objects.

5. The method according to claim 2 wherein said edge processing step detects features by performing:

a parabolic smoothing step;

a non-integral sub-sampling step at a predefined granularity;

a sobel edge detection step;

a true peak detection step; and

a chaining step.

6. The method according to claim 2 wherein said matching step includes the steps of:

matching features from a first image to a second image to identify disparities;

constraining an initial set of possible matches of said disparities for each feature using the an epipolar constraint;

characterizing each of said possible matches by an initial strength of match (SOM), by comparing the strength and orientation of said edgelets; and

enforcing a smoothness constraint within a preselected allowable disparity gradient.

7. The method according to claim 6 wherein said step of enforcing a smoothness constraint comprises the steps of:

updating the SOM of each correspondence comparing correspondences neighboring features under consideration; and

enforcing uniqueness by iteratively identifying matches having a maximum matching strength for both of its constituent features and eliminating all other matches associated with each constituent of the identified match.

8. The method according to claim 6 wherein said first and second image comprise a right and left image:

wherein features from said right and left images are merged to identify horizontal disparities; and

further matching features from a either said right or left image to a top image to identify vertical disparities.

9. The method according to claim 3 wherein said merging step includes the steps of multiplexing said disparities by:

selecting said horizontal disparities to be passed along if an orientation of said feature is between 45 and 135 or between 225 and 315; and

selecting said vertical disparities to be passed along if said orientation of said feature is not between 45 and 135 or between 225 and 315.

10. The method according to claim 4 wherein said step of segmenting includes the steps of:

generating initial clusters according to chain organization of said edgelets;

breaking chains of features into contiguous segments based on abrupt changes in z between successive points; and

merging two closest clusters based on a minimum distance criteria.

11. The method according to claim 4 wherein said segmenting step includes the step of selecting only objects wherein a 2D distance between the objects along a particular plane exceed a preset spacing threshold.

12. The method according to claim 1 wherein said step of computing a set of 3D features includes the steps of:

rectifying right and left images to generate a right and left rectified image;

matching features from said right and left rectified image to produce a dense disparity image;

edge-processing either said right or said left rectified image to generate a plurality of connected edgelets;

identifying connected edgelets having length greater than a predetermined threshold as features;

mapping locations of said features into said dense disparity image to sparsified disparities

computing 3D locations of feature points according to said sparsified disparities and camera geometry.

13. The method according to claim 1 wherein said step of filtering further comprises the steps of:

converting said 3D features to a ground plane coordinate system;

eliminating features having excessive or insufficient range, excessive lateral distance, excessive height, or insufficient distance from said ground plane;

projecting remaining features into said ground plane to generate projected features;

converting said projected features to a 2D image;

obtaining distinct regions wherein each pixel represents a plurality of feature points;

scoring features in said distinct region using a scoring function to generate region scores;

accumulating said region scores and comparing said accumulated scores to a predetermined threshold to determine if an object is present or absent.

14. The method according to claim 1 wherein said step of computing a trajectory further comprises the step of correlating segmented features in a first frame with features around an expected object position in a following frame;

15. A method of computing an object's trajectory comprising the steps of:

acquiring a stereo image of at least part of said object;

computer a set of 3D features from said stereo image;

filtering ground plane noise from said set of 3D features to generate a set of filtered 3D features; and

computing a trajectory of said set of filtered 3D features by: correlating filtered 3D features in an area around a suspected position of said part in a following frame.

16. A method of determining an object's trajectory by viewing an area with stereo cameras;

generating a feature when an object enters said viewing area;

measuring a height of said feature relative to a ground plane;

clustering said features having a height above said ground plane in 3D space to generate objects; and

tracking said objects in multiple frames.

17. A method for monitoring a passageway comprising:

providing a plurality of 3D images of a passageway over a duration of time, the plurality of 3D images comprising a reference image and a disparity map;

calculating at least one motion vector for the duration of time using the reference image and disparity map; and

monitoring the passageway using the at least one motion vector.